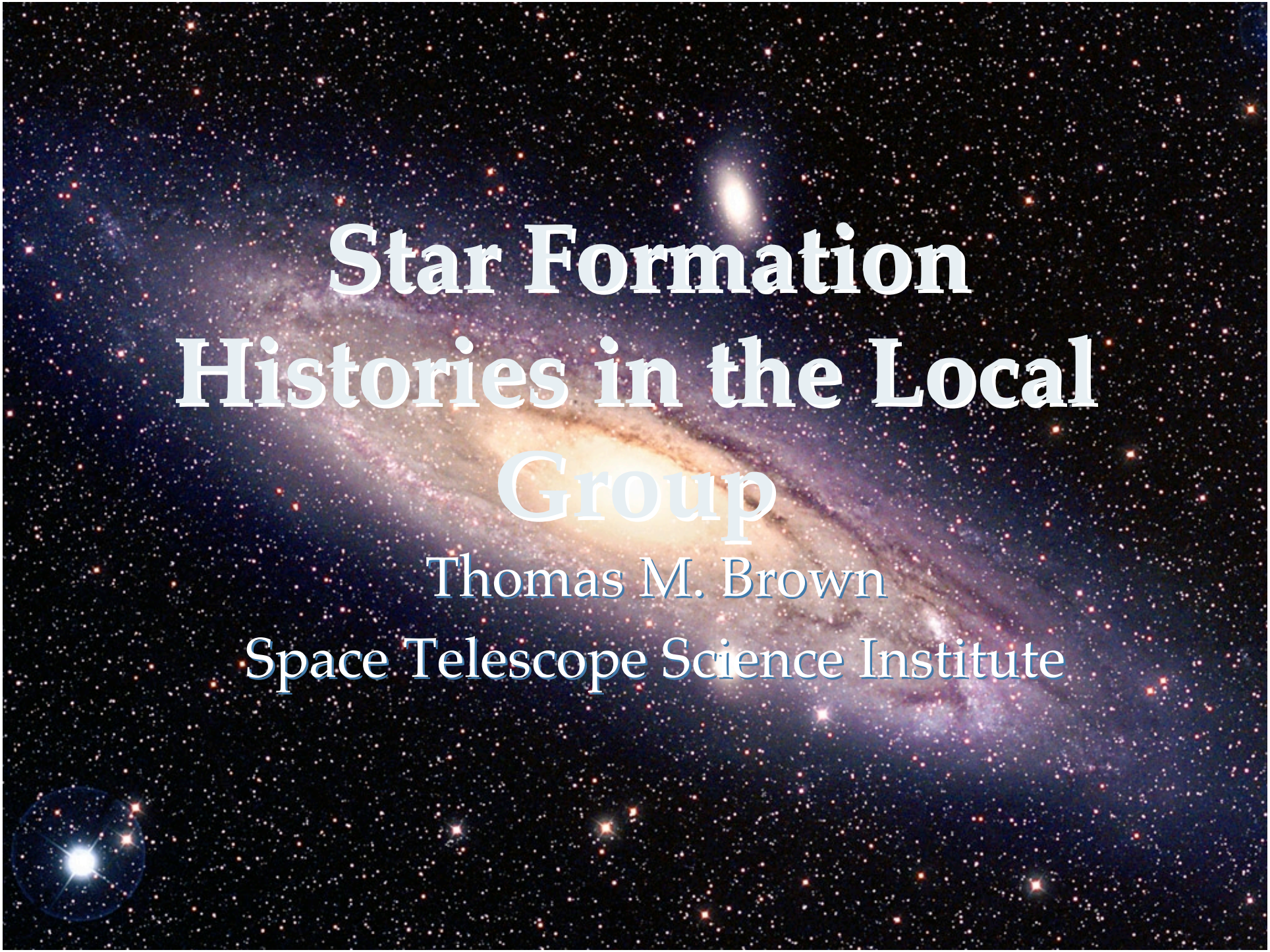
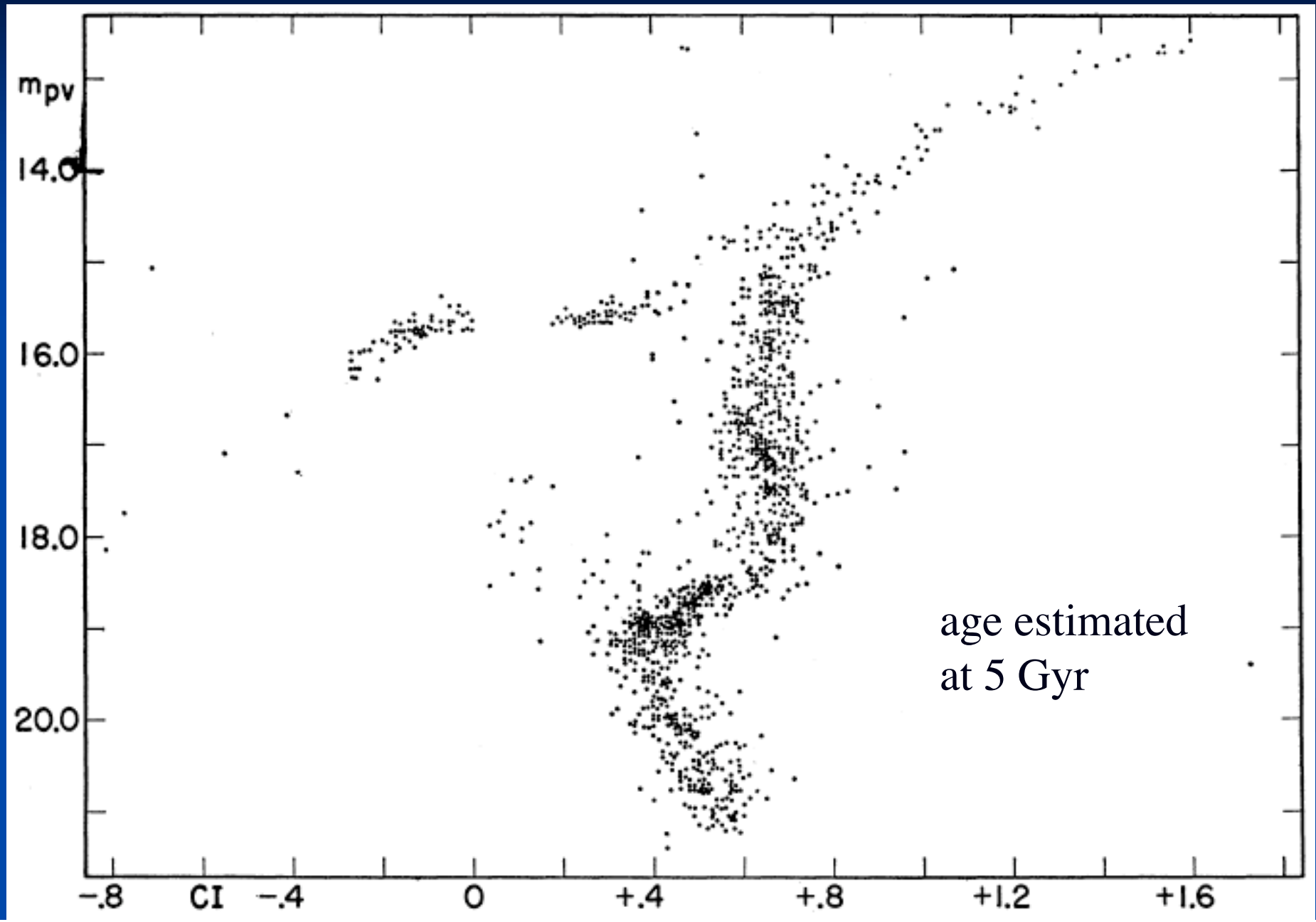
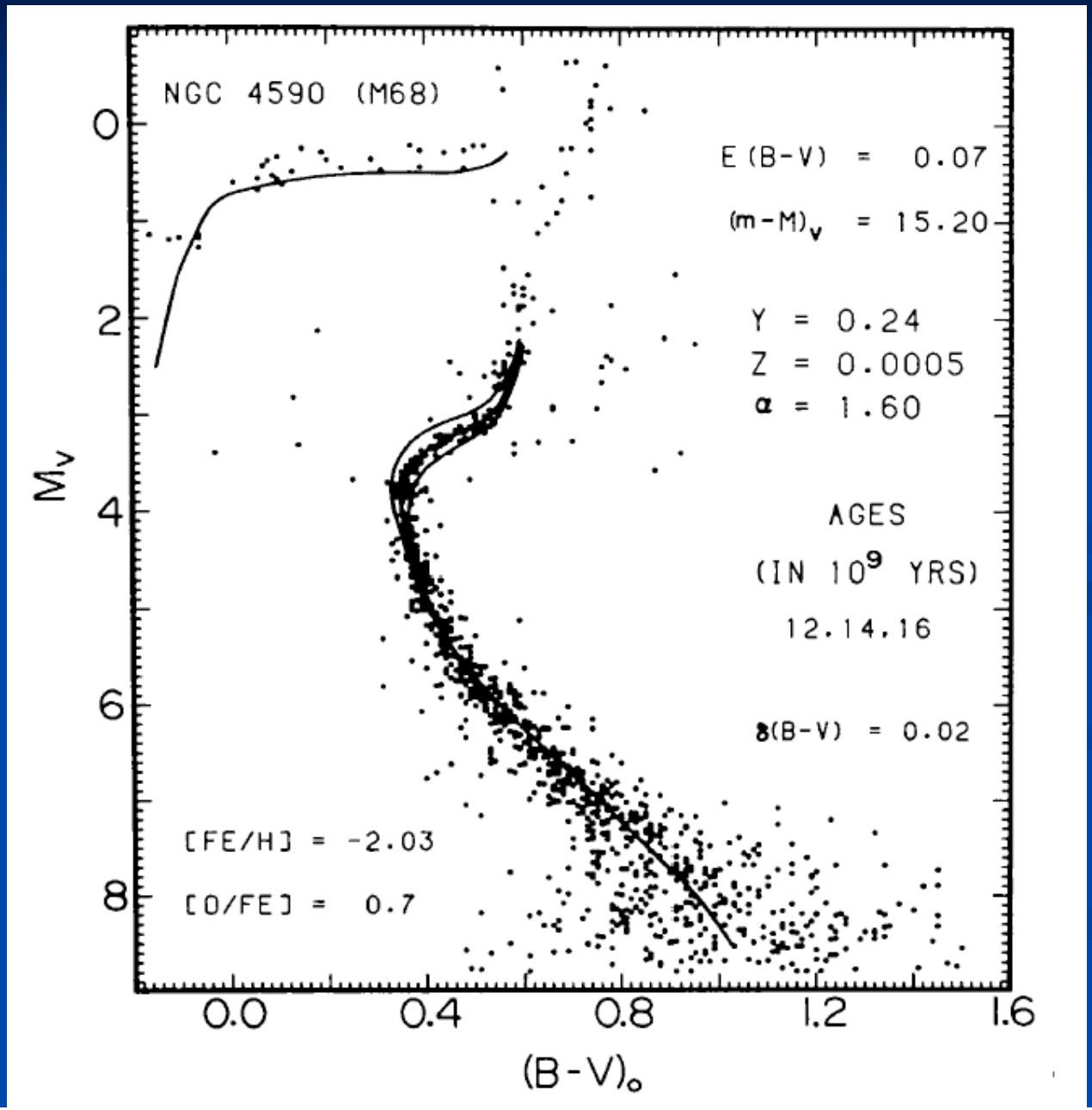

Star Formation Histories in the Local Group
Thomas M. Brown
Space Telescope Science Institute


Collaborators
Harry Ferguson, Ed Smith (STScI)
Randy Kimble, Allen Sweigart (GSFC)
Alvio Renzini (ESO)
Mike Rich (UCLA)
Don VandenBerg (U. of Victoria)

Globular Cluster M3 -Sandage 1953

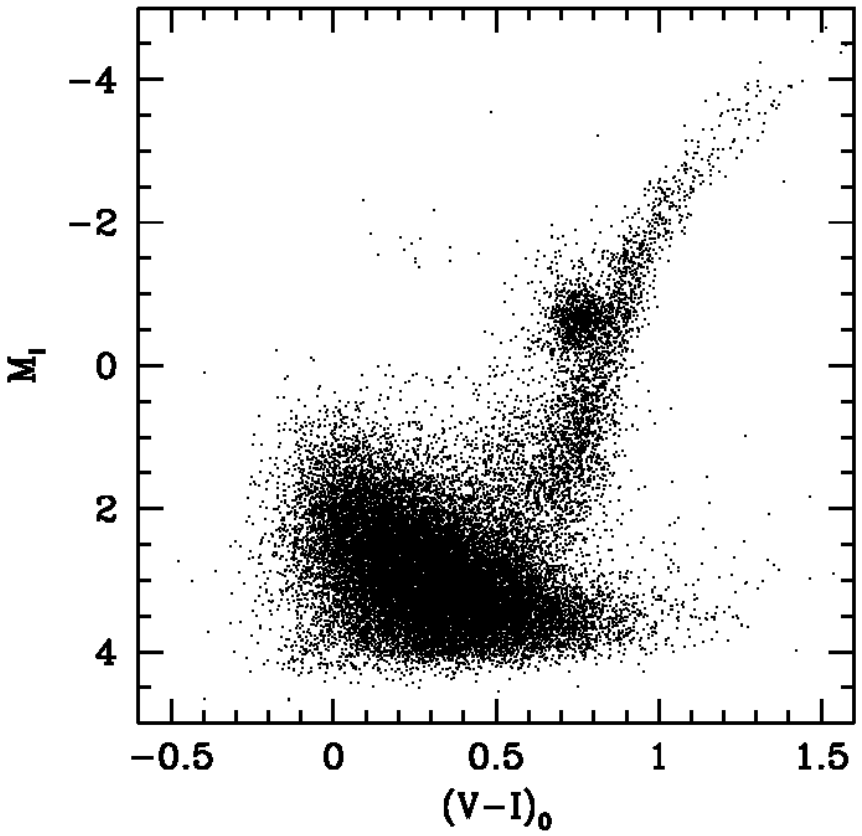


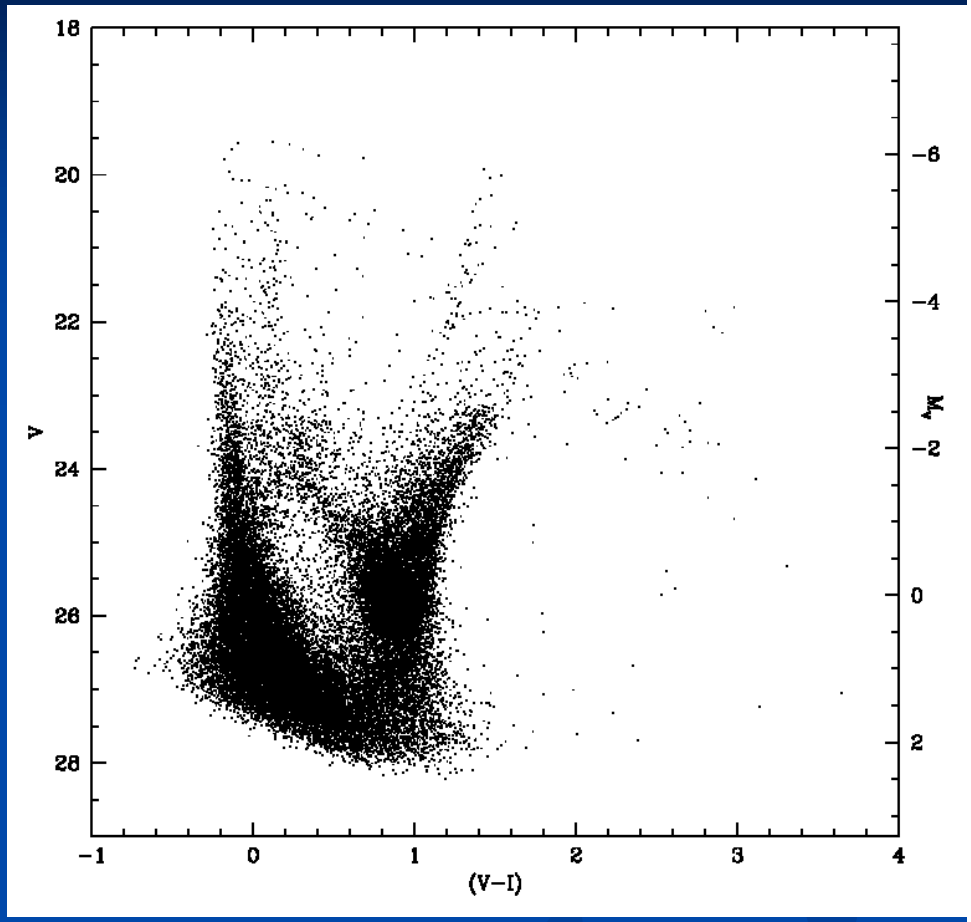
Globular Cluster M68 - VandenBerg 1988



HST Opens up the Local Group

Gallart et al. 1999
Leo I = dSph at 270 kpc
bulk of population 2-6 Gyr old





Dohm-Palmer et al. 1997, 2002
Dolphin et al. 2003
Sextans A = dIr at 1.3 Mpc
star formation increased 2 Gyr ago

HST/ACS can trace the oldest stars in the Local Group

- Improved resolution, field, and sensitivity over WFPC2
- Allows old main sequence to be resolved in populations out to edge of Local Group
- Star formation histories can now be constrained for the oldest populations in the Local Group

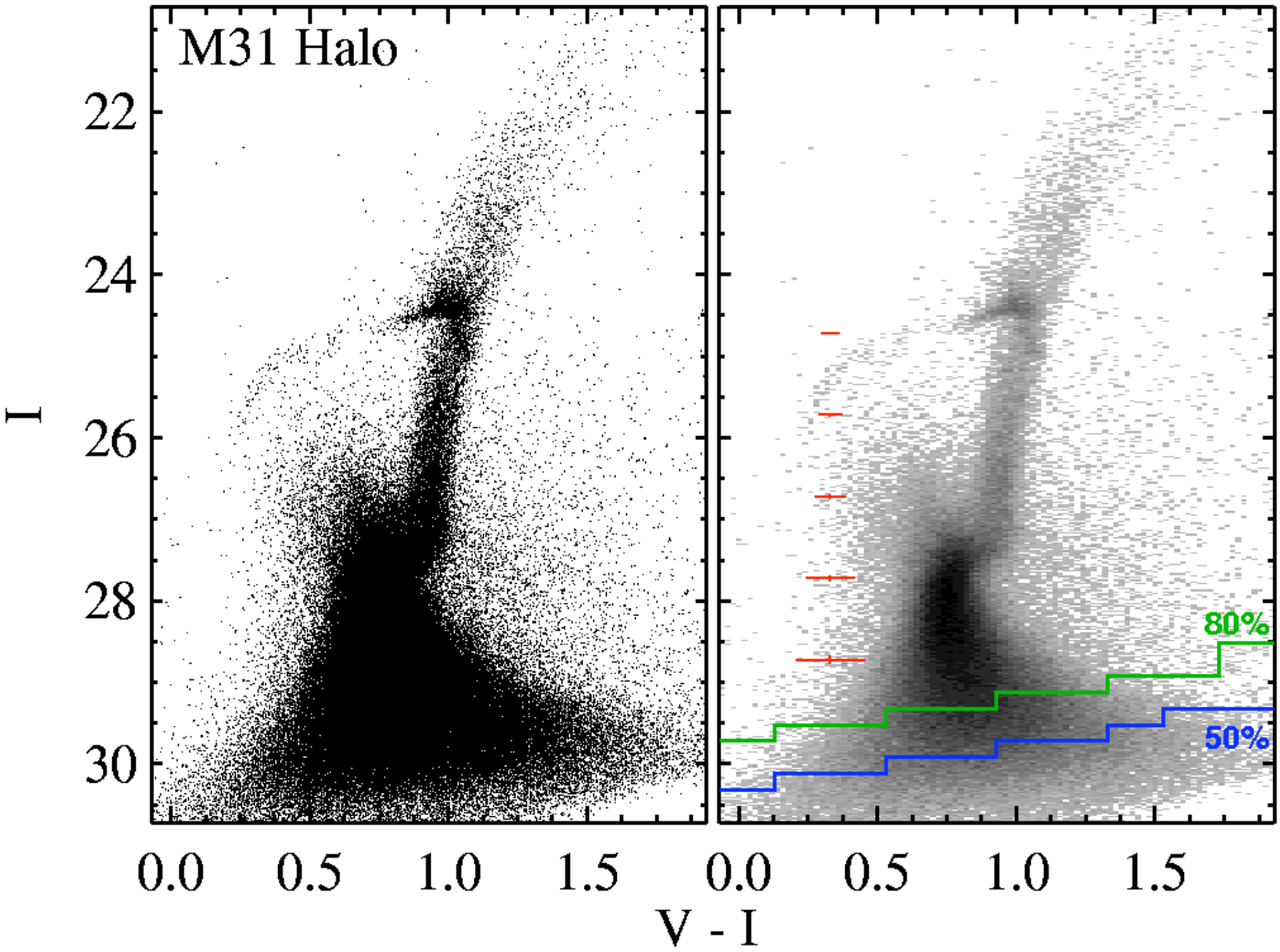
Field Position

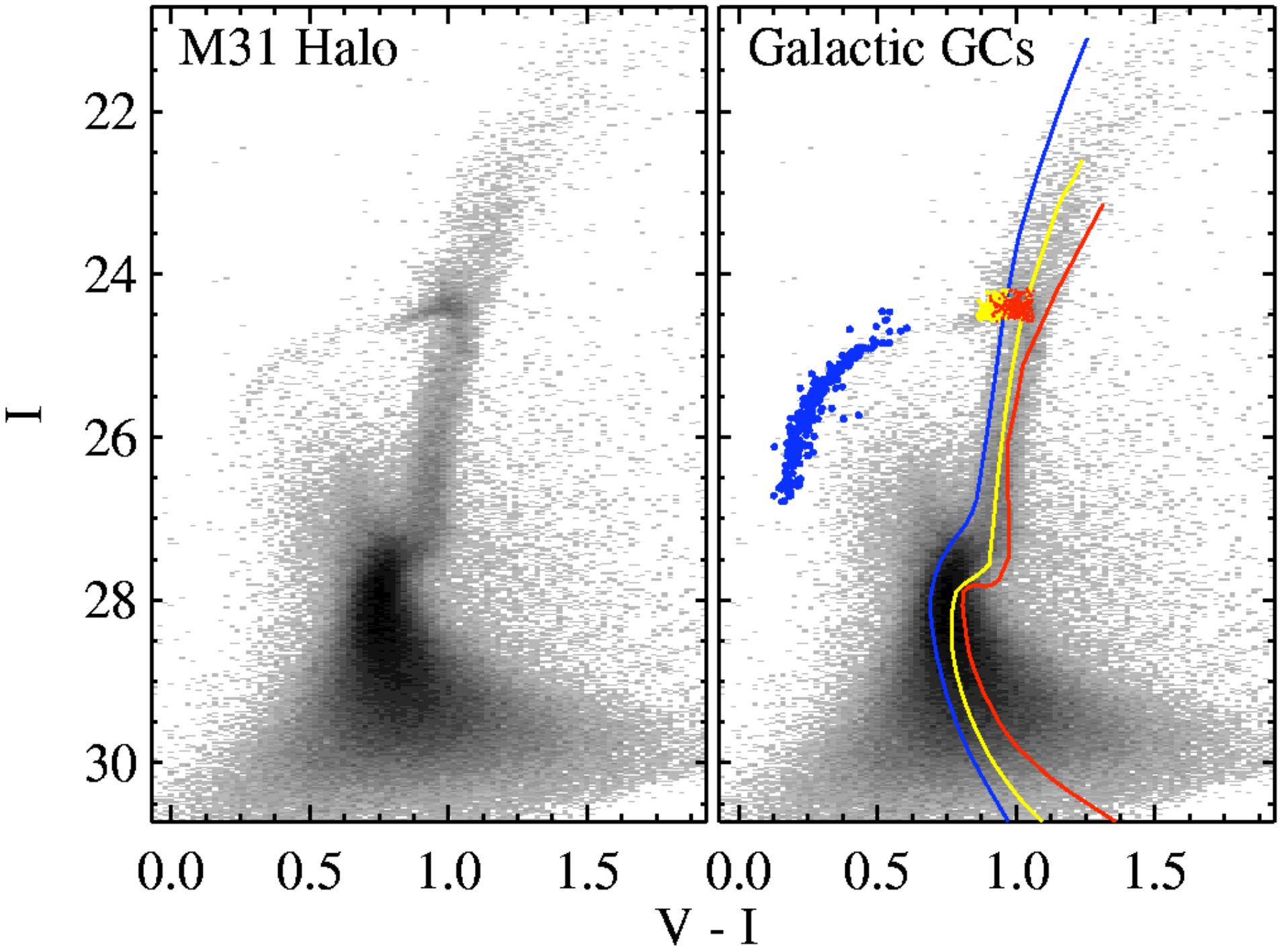
51 arcmin (11 kpc) from nucleus

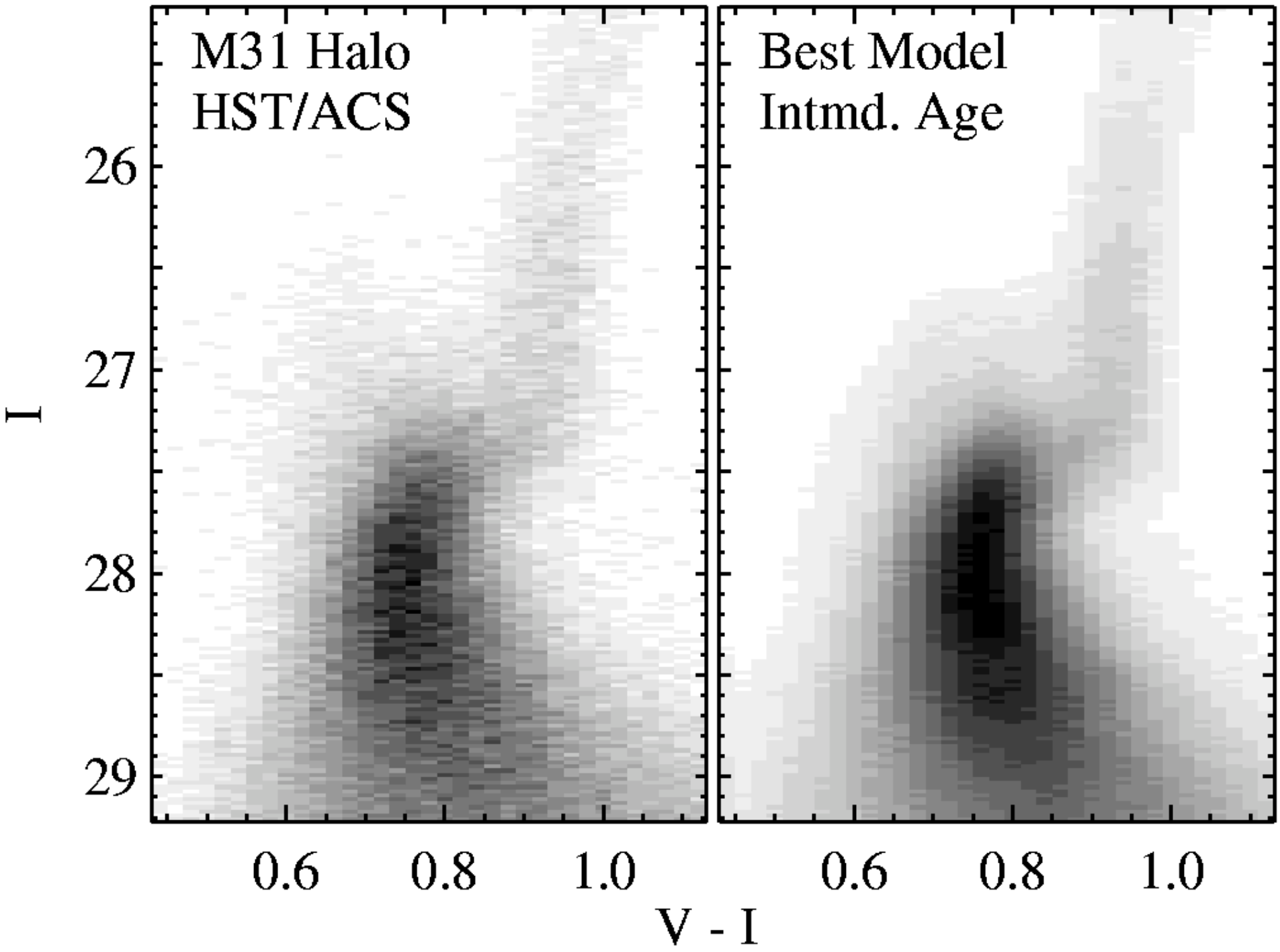
HST/ACS
M31 halo
field
210″x220″

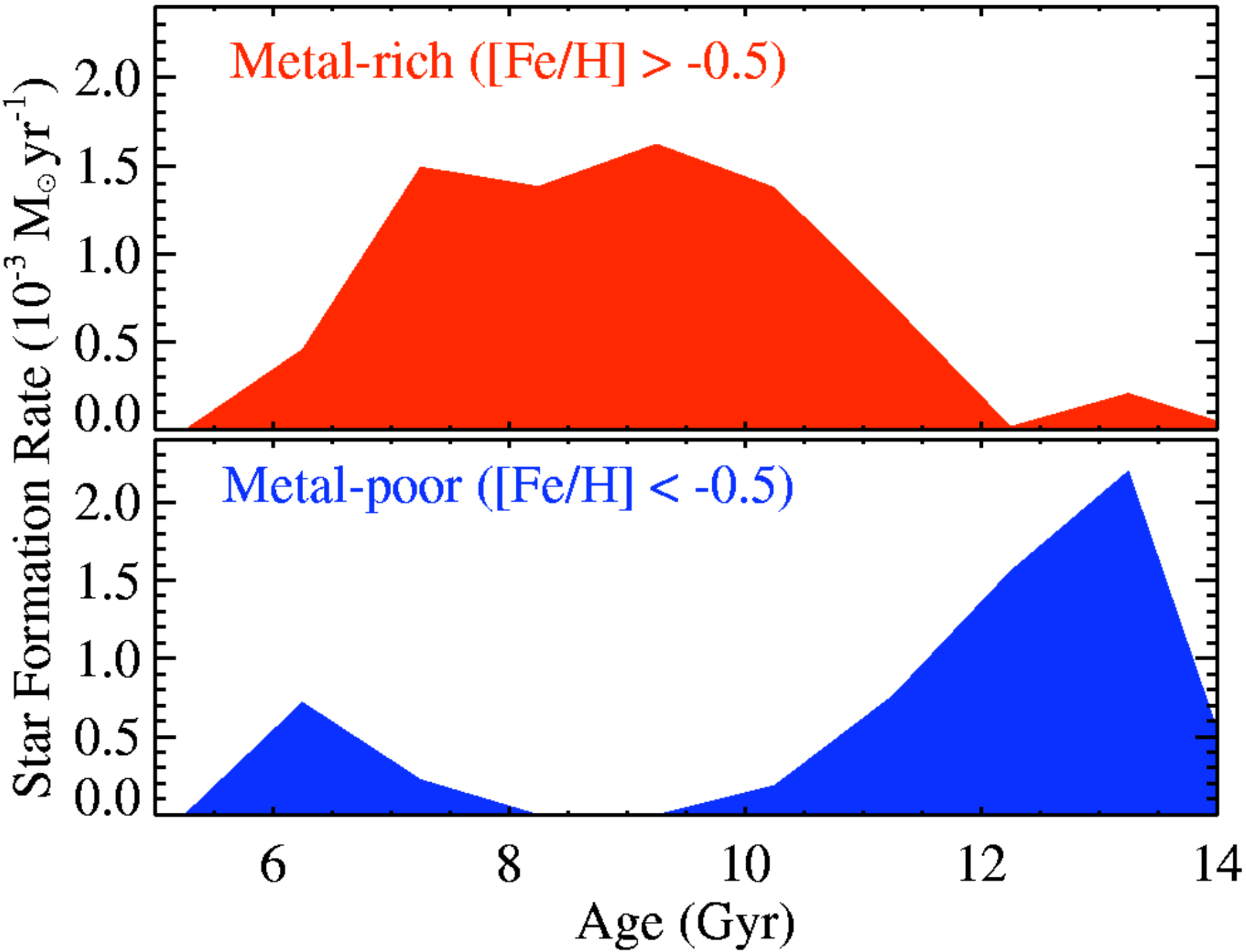
121 orbits

Brown
et al. 2003

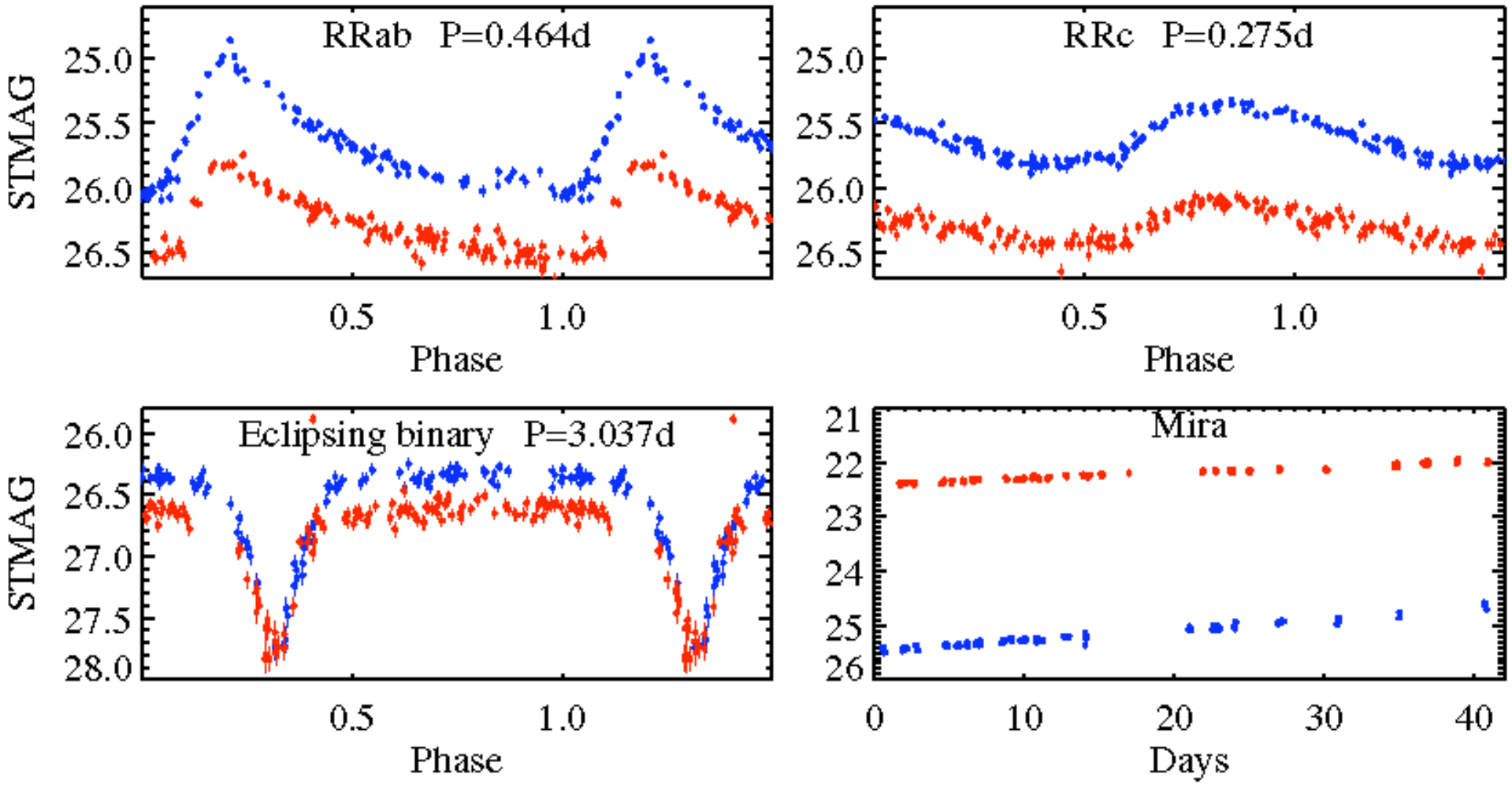

M31 Halo
22
24
26
28
30
I
0.0
0.5
1.0
1.5
0.0
0.5
1.0
1.5
V - I
80%
50%

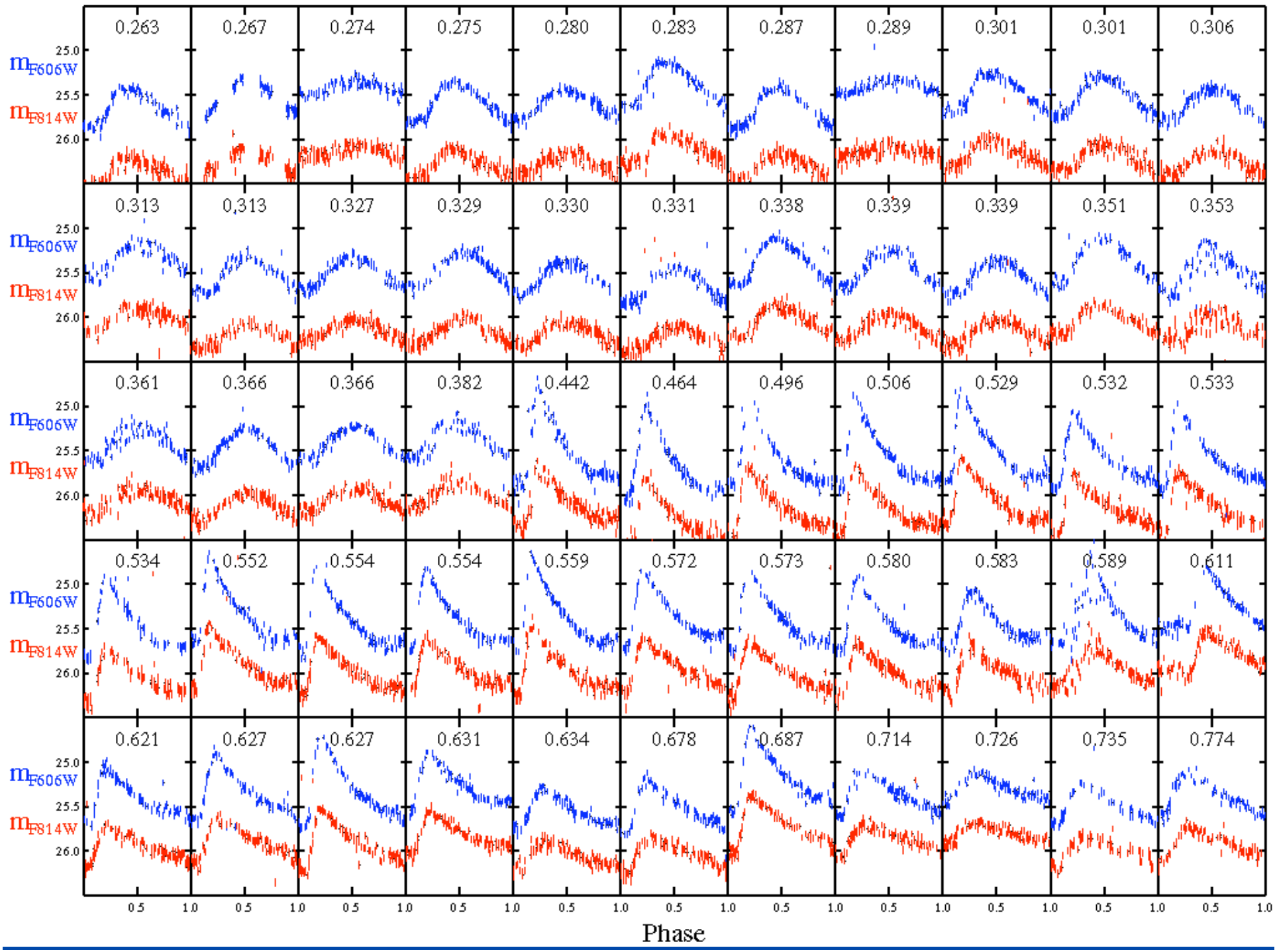

M31 Halo
Galactic GCs
22
24
26
28
30
I
0.0
0.5
1.0
1.5
0.0
0.5
1.0
1.5
V - I


M31 Halo
HST/ACS
Best Model
Intmd. Age
26
27
28
29
I
0.6
0.8
1.0
0.6
0.8
1.0
V - I


Metal-rich ([Fe/H] > -0.5)
Metal-poor ([Fe/H] < -0.5)
Star Formation Rate (10^{-3} $M_\odot yr^{-1}$)
0.0
0.5
1.0
1.5
2.0
6
8
10
12
14
Age (Gyr)

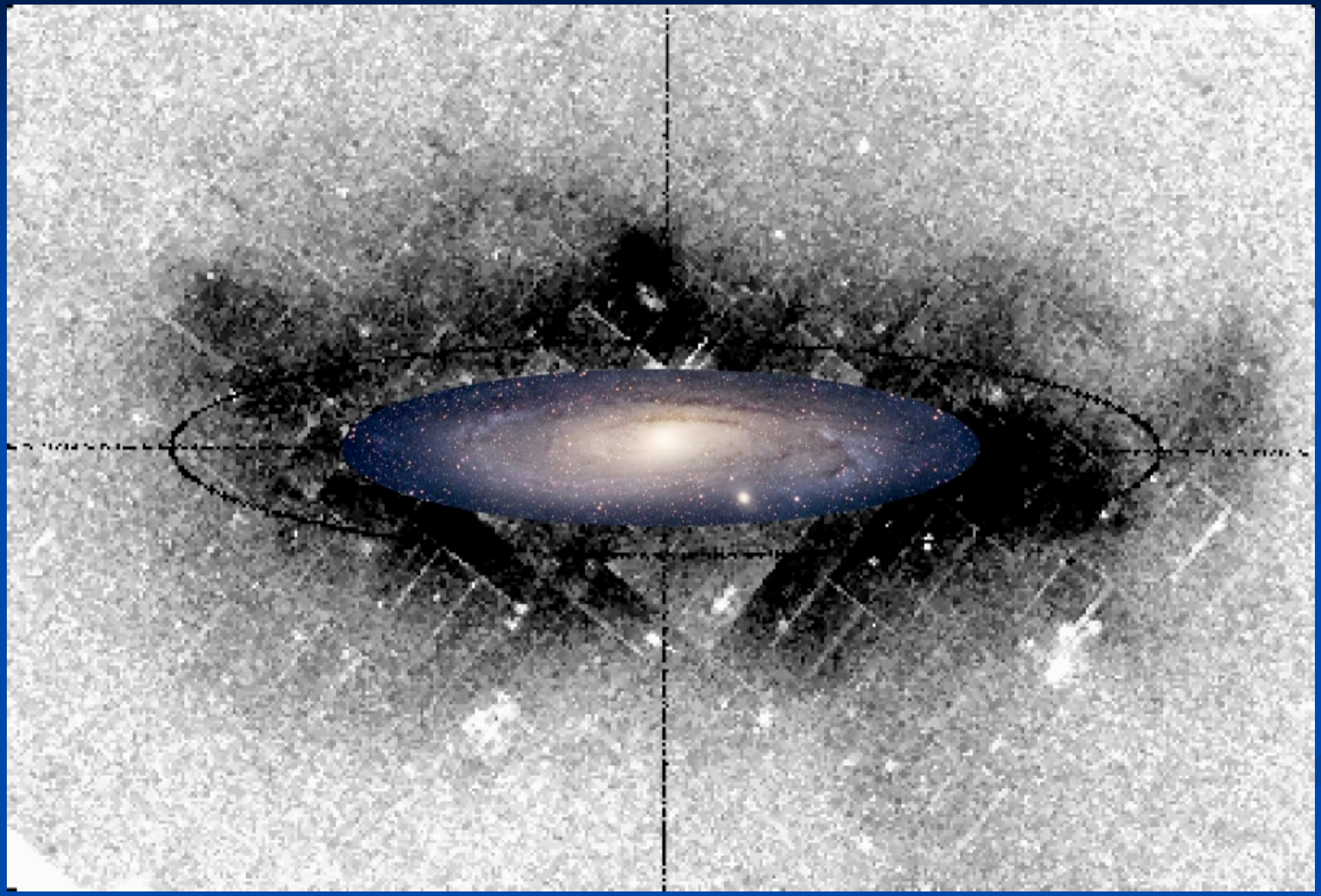
Light curves



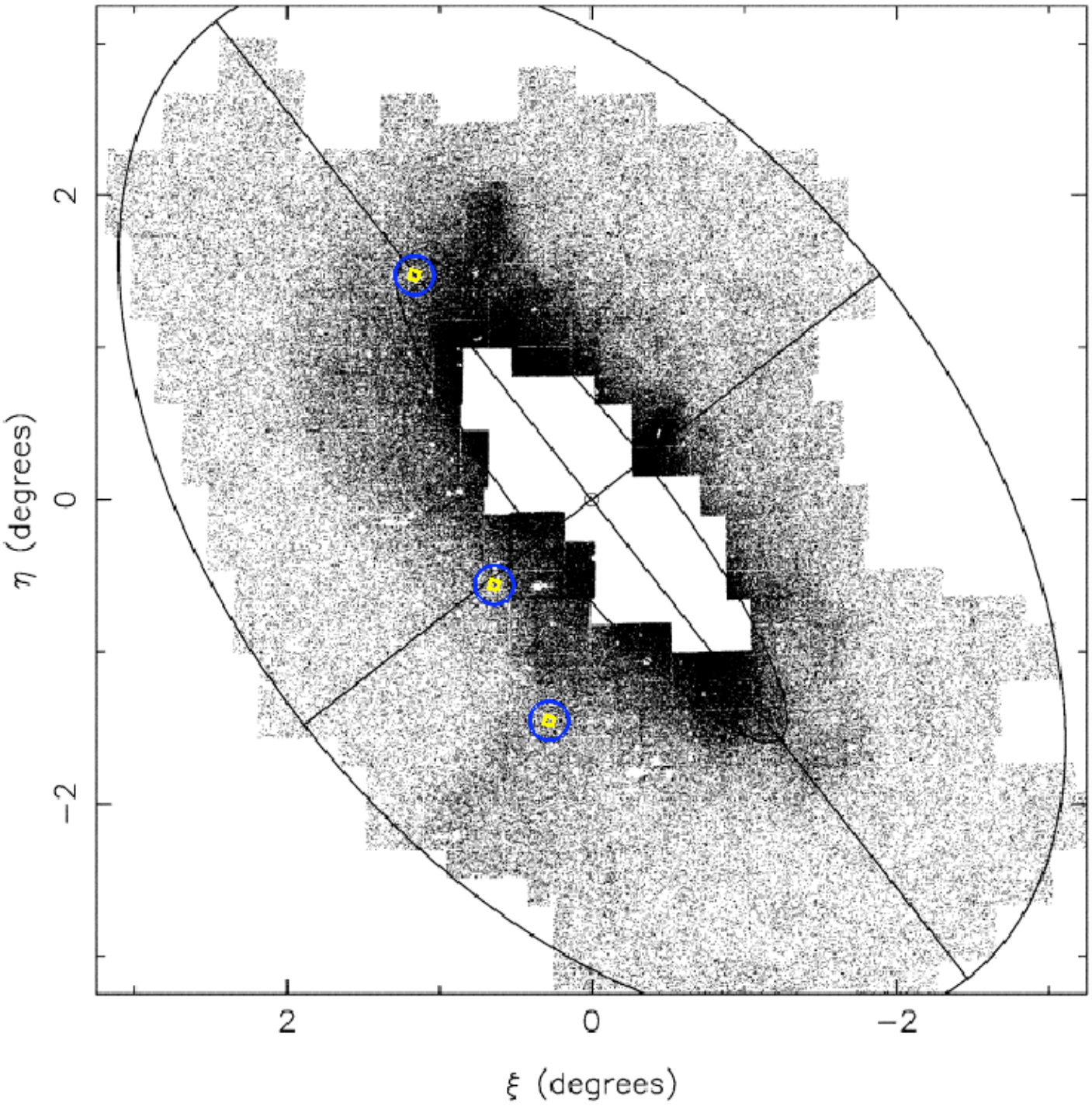

0.263
0.267
0.274
0.275
0.280
0.283
0.287
0.289
0.301
0.301
0.306
0.313
0.313
0.327
0.329
0.330
0.331
0.338
0.339
0.339
0.351
0.353
0.361
0.366
0.366
0.382
0.442
0.464
0.496
0.506
0.529
0.532
0.533
0.534
0.552
0.554
0.554
0.559
0.572
0.573
0.580
0.583
0.589
0.611
0.621
0.627
0.627
0.631
0.634
0.678
0.687
0.714
0.726
0.735
0.774
m_F606W
m_F814W
25.0
25.5
26.0
0.5
1.0
Phase

Optical Image

Star Counts (Ferguson et al. 2002)



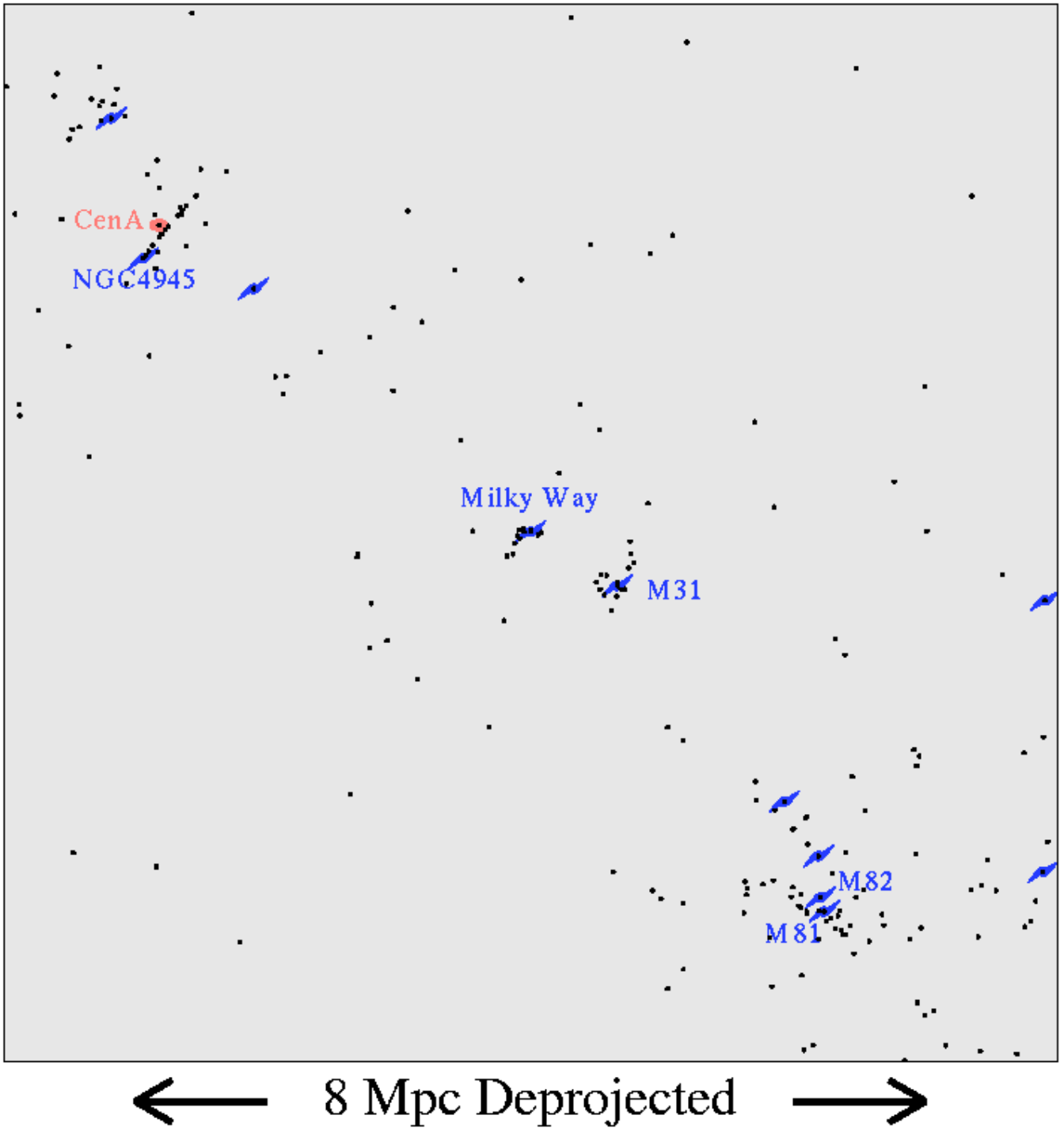
Cycle 11 & 13 Fields



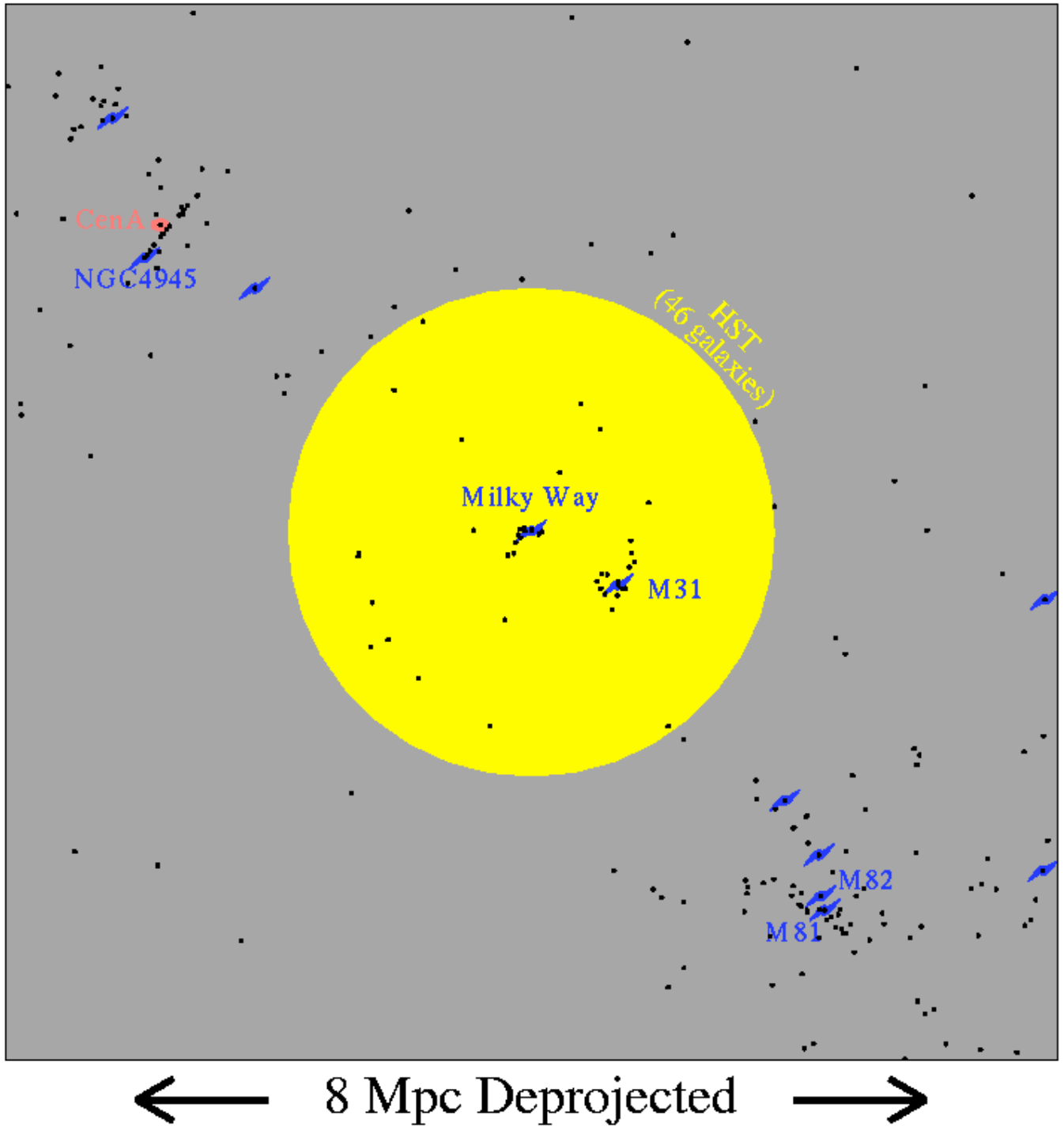
Where to go from here?

- HST can only sample a few tiny core samples through Local Group galaxies in the remaining mission
- JWST can also measure star formation histories, but CMDs constructed from IR bands are not as sensitive
- A Wide-Field imager with an HST-size aperture could fully explore Local Group galaxies
- TPF-C could extend our reach beyond the Local Group, but probably limited to smaller fields.

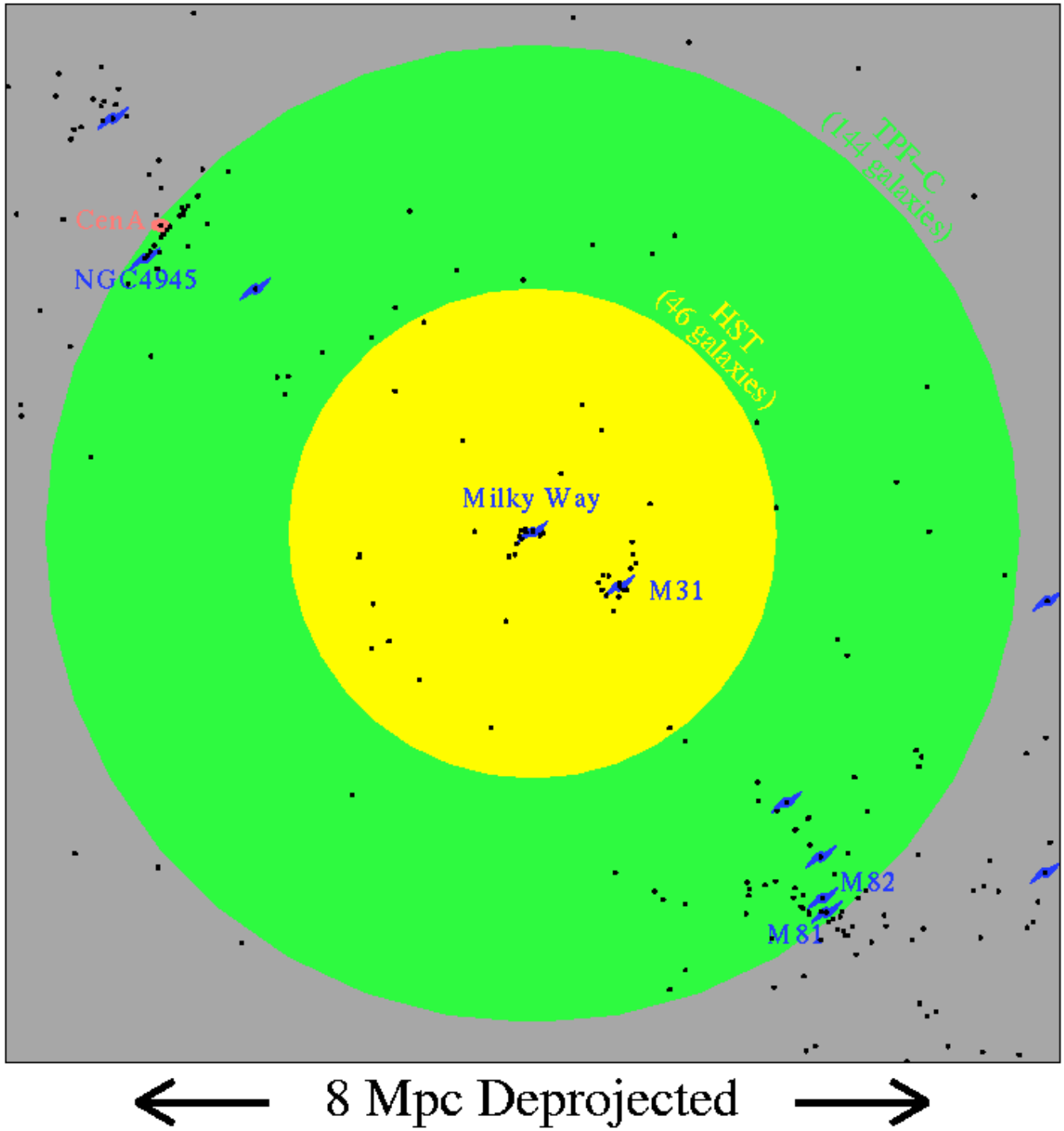
Nearby Galaxies



Nearby Galaxies



Nearby Galaxies



Program for a Wide-Field 2.4 m Telescope

- Tile Local Group galaxies with 1-hour exposures (gets below HB)
- Use secondary age/metallicity diagnostics on HB and RGB to determine scale of population variations
- Follow-up with 20% fill factor, 1.5 day exposures to get 1 mag below MSTO
- Complete maps of star formation history

Summary

- With large gains in field, sensitivity, and resolution, HST/ACS can measure star formation histories for populations of any age and any distance in the Local Group
- However, HST will only scratch the surface in the remaining mission
- Future missions can "solve" Local Group star formation by increasing the field size
- Larger apertures will increase the sample of giant galaxies beyond the two currently available for study (Milky Way & M31)